

I claim:

1. A method for compensating for polarization mode dispersion in an optical fiber communication system, comprising the steps of:
  - 5 reducing said polarization mode dispersion using a cascade of all-pass filters; and adjusting coefficients of said all-pass filters using a least mean square algorithm.
- 10 2. The method of claim 1, wherein said cascade of all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.
- 15 3. The method of claim 1, wherein said coefficient values are adjusted to minimize a cost function.
4. The method of claim 1, further comprising the step of measuring said polarization mode dispersion in a received optical signal.
- 20 5. The method of claim 4, wherein said measuring step employs a tunable narrowband optical filter to render information from energy detector measurements.
6. The method of claim 1, wherein said least mean square algorithm adjusts said coefficients as follows:

$$25 \quad w(n+1) = w(n) - \mu \nabla(J),$$

where  $w$  is a composite coefficient vector defined as:

$$w = \begin{bmatrix} a \\ b \end{bmatrix}, \quad \nabla(J) = \begin{bmatrix} \frac{\partial J}{\partial a^T} & \frac{\partial J}{\partial b^T} \end{bmatrix}^T$$

is the  $(P + Q) \times 1$  complex gradient of  $J$  with respect to  $w$ , and

$$\frac{\partial J}{\partial a^T} = \begin{bmatrix} \frac{\partial J}{\partial a_1} & \frac{\partial J}{\partial a_2} & \dots & \frac{\partial J}{\partial a_P} \end{bmatrix}, \text{ and}$$

$$\frac{\partial J}{\partial b^T} \equiv \begin{bmatrix} \frac{\partial J}{\partial b_1} & \frac{\partial J}{\partial b_2} & \dots & \frac{\partial J}{\partial b_Q} \end{bmatrix}.$$

7. A method for compensating for polarization mode dispersion in an optical fiber communication system, comprising the steps of:
- 5 reducing said polarization mode dispersion using a cascade of all-pass filters; and
- adjusting coefficients of said all-pass filters using a Newton algorithm.
8. The method of claim 7, wherein said cascade of all-pass filters comprises a
- 10 two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.
9. The method of claim 7, wherein said coefficient values are adjusted to minimize a cost function.
- 15
10. The method of claim 7, further comprising the step of measuring said polarization mode dispersion in a received optical signal.
11. The method of claim 10, wherein said measuring step employs a tunable
- 20 narrowband optical filter to render information from energy detector measurements.
12. The method of claim 7, wherein said Newton algorithm adjusts said coefficients as follows:
- $$w(n+1) = w(n) - \mu H^{-1} \nabla(J)$$
- 25 where  $w$  is a composite coefficient vector defined as:
- $$w = \begin{bmatrix} a \\ b \end{bmatrix}, \nabla(J) \equiv \begin{bmatrix} \frac{\partial J}{\partial a^T} & \frac{\partial J}{\partial b^T} \end{bmatrix}^T$$
- $\frac{\partial J}{\partial a^T} \equiv \begin{bmatrix} \frac{\partial J}{\partial a_1} & \frac{\partial J}{\partial a_2} & \dots & \frac{\partial J}{\partial a_P} \end{bmatrix}$ , is the  $(P+Q) \times 1$  complex gradient of  $J$  with respect to  $w$ ,
- a Hessian matrix,  $H$ , is defined as follows:

$$H = \frac{\partial^2 J}{\partial w \partial w^T} = \begin{bmatrix} \frac{\partial^2 J}{\partial a \partial a^T} & \frac{\partial^2 J}{\partial a \partial b^T} \\ \frac{\partial^2 J}{\partial b \partial a^T} & \frac{\partial^2 J}{\partial b \partial b^T} \end{bmatrix} \text{ and}$$

$$\frac{\partial J}{\partial b^T} = \begin{bmatrix} \frac{\partial J}{\partial b_1} & \frac{\partial J}{\partial b_2} & \dots & \frac{\partial J}{\partial b_q} \end{bmatrix}.$$

13. A polarization mode dispersion compensator in an optical fiber  
5 communication system, comprising:  
a cascade of all-pass filters having coefficients that are adjusted using a least mean square algorithm.
14. The polarization mode dispersion compensator of claim 13, wherein said  
10 cascade of all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.
15. The polarization mode dispersion compensator of claim 13, wherein said coefficient values are adjusted to minimize a cost function.
16. The polarization mode dispersion compensator of claim 13, further comprising the step of measuring said polarization mode dispersion in a received optical signal.
- 20 17. The polarization mode dispersion compensator of claim 16, wherein said measuring step employs a tunable narrowband optical filter to render information from energy detector measurements.
- 25 18. A polarization mode dispersion compensator in an optical fiber communication system, comprising:  
a cascade of all-pass filters having coefficients that are adjusted using a Newton algorithm.

19. The polarization mode dispersion compensator of claim 18, wherein said cascade of all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.

5 20. The polarization mode dispersion compensator of claim 18, wherein said coefficient values are adjusted to minimize a cost function.

21. The polarization mode dispersion compensator of claim 18, further comprising the step of measuring said polarization mode dispersion in a received optical  
10 signal.

22. The polarization mode dispersion compensator of claim 21, wherein said measuring step employs a tunable narrowband optical filter to render information from energy detector measurements.